

# First Record of *Platorchestia monodi* (Crustacea: Amphipoda: Talitridae) from the Pacific Region

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## ABSTRACT

*Platorchestia monodi* (Mateus et al., 1986), the beach hopper, commonly lives in sea shores and was previously reported only from the Atlantic regions, such as Mid-Atlantic islands, Brazilian coast, and Israel. We present the first record of this species in the Pacific region. The present species can be clearly distinguished from related species by the shapes of gnathopods 1-2 and development of sexual dimorphism in antenna 2 and pereopod 7. Descriptions of the diagnostic characteristics of the species are provided on the text. In addition, this paper also provided the partial sequence of the mitochondrial cytochrome c oxidase subunit 1 (CO1) gene of the species for its molecular characteristics.

**Keywords:** Talitridae, *Platorchestia monodi*, amphipod, taxonomy, CO1, Korea

## INTRODUCTION

The genus *Platorchestia* Bousfield, 1982 (Crustacea, Amphipoda), is one among 52 genera belonging to the family Talitridae, living in terrestrial and supra-littoral environments such as shores of rivers, grass lands, and small patches of leaf litter (Serejo and Lowry, 2008).

According to a recent study, this genus includes 17 described species, although the generic status of some species has been questioned (Jo, 1988; Serejo, 2004; Serejo and Lowry, 2008; Cheng et al., 2011). Moreover, this genus has been known as two cryptic species complexes such as *P. japonica* (Tattersall, 1922) and *P. platensis* (Krøyer, 1845) complexes (Jo, 1988; Miyamoto and Morino, 2004; Serejo, 2004; Serejo and Lowry, 2008; Cheng et al., 2011).

Recently, the mitochondrial cytochrome c oxidase subunit 1 (CO1) gene, which can distinguish species boundaries within most animal phyla, is very useful for DNA barcoding (Hajibabaei et al., 2006; Clare et al., 2007; Elsasser et al., 2009; Zemlak et al., 2009). Therefore, information derived from the CO1 gene sequence from different species is important for animal taxonomy.

In this paper, *Platorchestia monodi* (Mateus et al., 1986) is reported for the first time from the Pacific region. We also provided as CO1 gene sequence of this species for its molecular characteristics.

## MATERIALS AND METHODS

### Morphological taxonomy

Talitrids were collected under rotting hay on river mouth or sea shore in Korea between 2009 and 2010. They were immediately fixed on-site with 95% ethyl alcohol. The specimens were observed under both a stereomicroscope (Model SZX-ILLB2-200; Olympus, Tokyo, Japan) and a light microscope (Model DM 2500; Leica, Wetzlar, Germany). All dissected appendages were drawn using a microscope with a drawing tube attachment. Images were recorded using a microscope digital camera (Model Moticam 2000; Motic Incorporation Ltd., Hong Kong, China), and produced with Helicon Focus software (Model Helicon Focus; Helicon Soft Ltd., Kharkov, Ukraine). Classification system of crustacean setae follows Garm (2004) and Zimmer et al. (2009). All specimens examined here were deposited in the Department of Biological Sciences, Inha University, South Korea.

### Molecular taxonomy

Total genomic DNA was extracted from the pereopods of each specimen using a RED-Extract-N-Amp Tissue PCR Kit (Sigma, St. Louis, MO, USA) according to the manufacturer's instructions. The target DNA segment of the mitochondrial CO1 gene was amplified using the primers LCO1490 and HCO2198 (Folmer et al., 1994).

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Optimized PCR conditions were as follows: denaturation at 94°C for 2 min; followed by 10 cycles of denaturation at 94°C for 10 sec, annealing at 37°C for 30 sec, extension at 72°C for 60 sec; then followed by 25 cycles of denaturation at 94°C for 10 sec, annealing at 48°C for 30 sec, extension at 72°C for 60 sec; and final extension step at 72°C for 7 min.

The QIAquick PCR Purification Kit (Qiagen, Valencia, CA, USA) was used for the purification of PCR products. An ABI 3700 sequencer (Applied Biosystems, Foster City, CA, USA) was used for sequencing, and sequences obtained in this study were all deposited in GenBank.

## SYSTEMATIC ACCOUNTS

Order Amphipoda Latreille, 1816  
Family Talitridae Rafinesque, 1815  
Genus *Platorchestia* Bousfield, 1982

<sup>1</sup>\**Platorchestia monodi* (Mateus et al., 1986) (Figs. 1-4)  
*Orchestia monodi* Mateus, Mateus, and Afonso, 1986: 100-110, figs. 1-7.

*Platorchestia platensis* (Krøyer, 1845) forma *monodi* (Mateus et al., 1986): Stock and Biernbaum, 1994: 796-800, fig. 1.  
*Platorchestia monodi*: Morino and Ortal, 1995: 825-829, figs. 1-3; Stock, 1996: 150-156, figs. 2-4; Serejo, 2004: 14-21, figs. 7-9.

**Material examined.** Korea: Busan: 7♂♂ and 5♀♀, Saha-gu, Dadae-dong, Dadaepo Beach (35° 02'N, 128° 57'E), 26 Jun 2010, Kim MS; Gyeongsangbuk-do: 10♂♂ and 11♀♀, Yeongdeok-gun, Byeonggok-myeon, Songcheon Stream



**Fig. 1.** *Platorchestia monodi* (Mateus et al., 1986), male (lateral view). Scale bar=2 mm.

(36° 33'N, 129° 25'E), 10 Jun 2010, Kim MS; Incheon: 15♂♂ and 13♀♀, Ganghwa-gun, Gilsang-myeon, Onsu-cheon Stream (37° 38'N, 126° 31'E), 10 Sep 2009, Kim MS; 6♂♂ and 7♀♀, Ongjin-gun, Bukdo-myeon, Isl. Yongyudo, Wangsan Beach (37° 27'N, 126° 21'E), 8 May 2009, Kim MS; 13♂♂ and 11♀♀, Jung-gu, Sinheung-dong, Yeonangyo Bridge (37° 26'N, 126° 37'E), 23 Mar 2010, Kim MS; Ulsan: 12♂♂ and 10♀♀, Buk-gu, Myeongchon-dong, Taehwa River (35° 33'N, 129° 20'E), 13 Oct 2009, Kim MS.

**Description (male).** Body (Figs. 1, 2A) 9.3 mm. Eyes sub-round and black, width 0.4 times head diameter.

Antenna 1 (Figs. 1, 2B) not reaching peduncular article 5 of antenna 2; peduncular articles 1-3 subequal in length; peduncular articles 1-2 marginally bare ventrally, ventral margin of peduncular article 3 with one cuspidate seta; flagellum 6-articulate, each article with two groups of 2-3 simple setae distally.

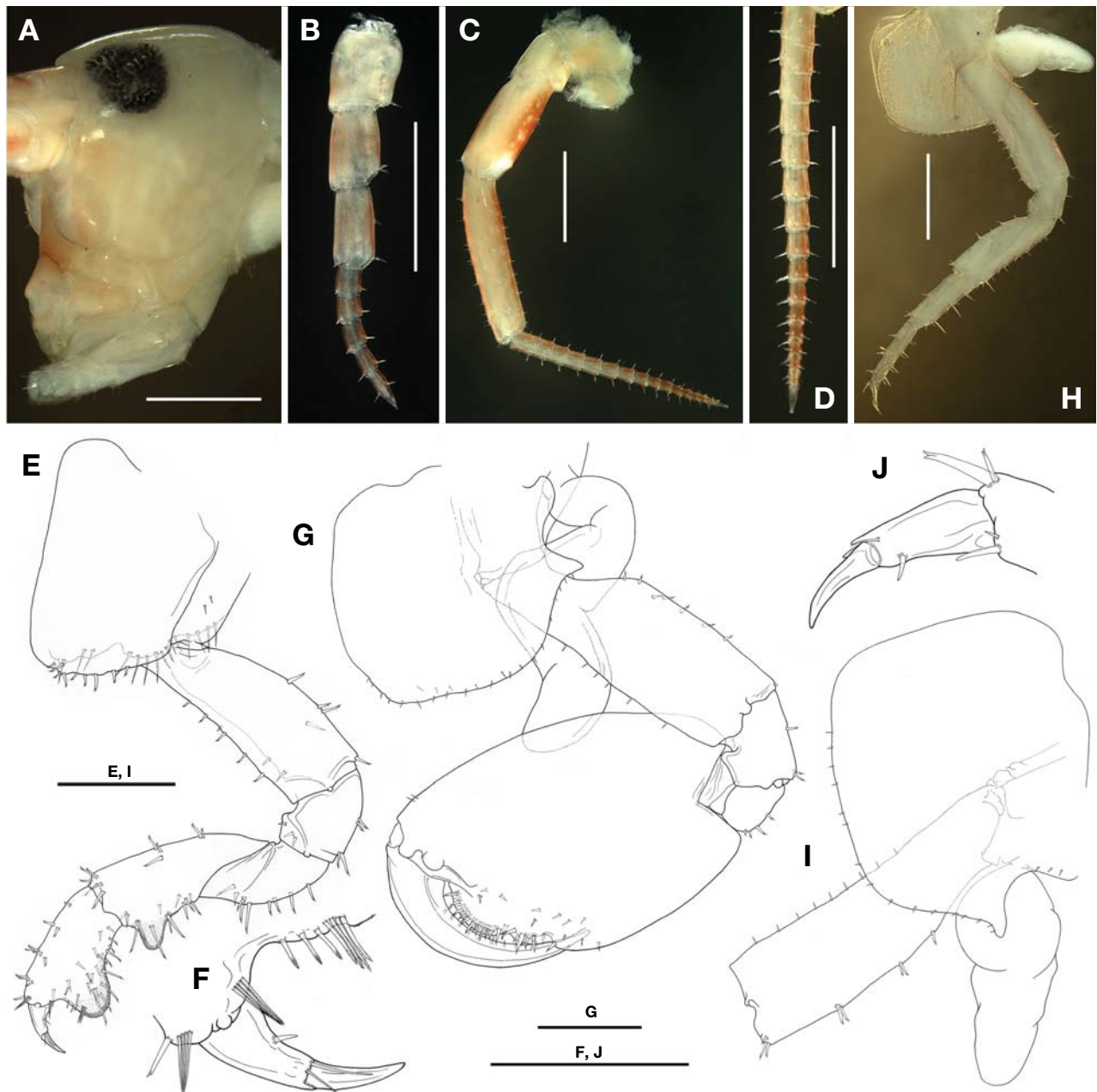
Antenna 2 (Figs. 1, 2C, D), 0.31 times as long as body length; peduncular articles 4-5 with length ratio of 1 : 1.3, weakly incrassate, bearing many short cuspidate setae, distal margin with simple setae; flagellum 1.44 times of peduncular article 5, with 16 articles, flagellum 2 proximal articles incompletely fused; each article with short simple setae distally.

Gnathopod 1 (Fig. 2E, F) cuspidactylate and subchelate; coxal plate 1 with two rows of many simple and cuspidate setae on ventral margin; basis straight, with eight cuspidate setae on anterior margin and four cuspidate setae on posterior margin; merus with nine cuspidate setae on posterior margin; carpus with two groups of 2-3 cuspidate setae on dorsal margin, posterior margin with tumescent hump, seven lateral, and six medial setae; propodus 0.63 times as long as carpus, with four groups of 1-4 cuspidate setae on dorsal margin and tumescent hump posteriorly, lateral margin with 12 setae, medial margin with 11 setae; dactyl with one simple seta on inner margin and two simple setae at hinge of unguis.

Gnathopod 2 (Fig. 2G) powerfully subchelate; coxal plate 2 with many simple setae on ventral margin, posterior cusp obtuse; basis straight, with six cuspidate setae on anterior margin, posterior margin with seven cuspidate setae; propodus oval in shape, posterior margin marginally bare and palmar margin fringed with many short simple and cuspidate setae, with two protrusions, these protrusions wide and shallow, anterior one about 1.9 times as long as posterior one; dactyl strongly curved, inner margin with many simple setae, distal part narrowed.

Pereopods 3-4 (Figs. 2H-J, 3A-C) cuspidactylate; coxal plate 3 sub-rectangular, with many simple setae on ventral margin, posterior margin with cusp; basis straight, with nine

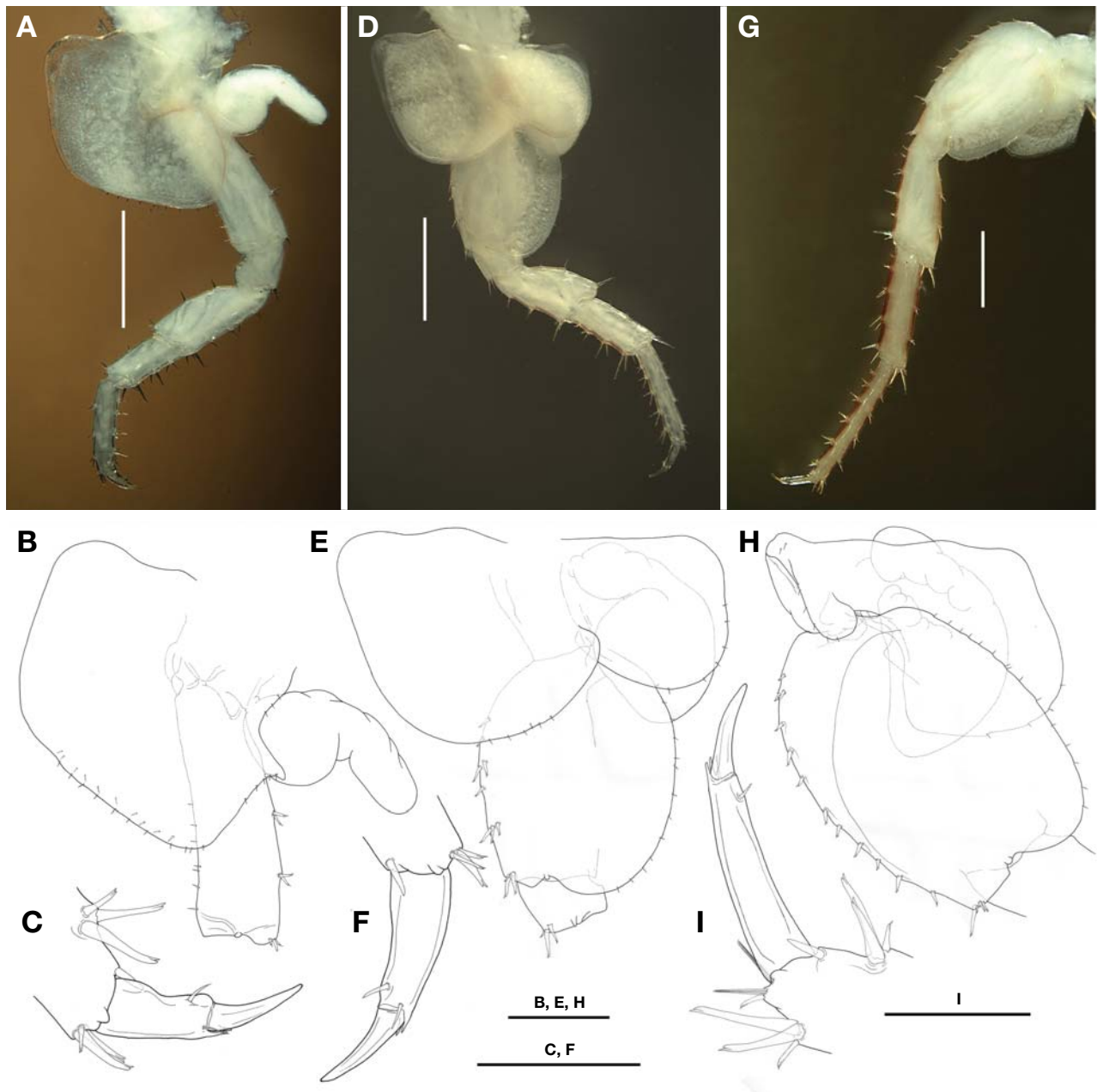
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**Fig. 2.** *Platorchestia monodi*, male. A, Head; B, Antenna 1; C, Antenna 2; D, Flagellum articles of antenna 2; E, Gnathopod 1; F, Palmar margin of gnathopod 1; G, Gnathopod 2; H, Pereopod 3; I, Coxal plate and basis of pereopod 3; J, Dactyl of pereopod 3. Scale bars: A-D, H=1 mm, E, G, I=0.5 mm, F, J=0.25 mm.

cuspidate setae on anterior margin, posterior margins with three groups of 1-2 cuspidate setae; merus to propodus with several groups of 1-3 cuspidate setae on anterior and posterior margins; dactyl with two simple setae at hinge of unguis; pereopod 4 resembling pereopod 3, but posterior corner of coxal plate 4 weakly expanded and dactyl slightly thickened and pinched posteriorly.

Pereopods 5-7 (Figs. 3D-I, 4A, B) cuspidactylate; coxal plates 5-6 bilobate, anterior lobe of coxal plate 5 larger than posterior one, while anterior lobe of coxal plate 6 very small and posterior lobe lacking process; coxal plate 7 non-lobate; basis of pereopods 5-7 oval in shape, with 13-15 simple setae on posterior margin, anterior margin with 5-12 groups of 1-3 cuspidate setae; merus to dactyls resembling pereopod 3.



**Fig. 3.** *Platorchestia monodi*, male. A, Pereopod 4; B, Coxal plate and basis of pereopod 4; C, Dactyl of pereopod 4; D, Pereopod 5; E, Coxal plate and basis of pereopod 5; F, Dactyl of pereopod 5; G, Pereopod 6; H, Coxal plate and basis of pereopod 6; I, Dactyl of pereopod 6. Scale bars: A, D, G=1 mm, B, E, H=0.5 mm, C, F, I=0.25 mm.

Gills 2-6 (Figs. 2G, H, I, 3A, B, D, E, G, H) present; gill 2 elongated and curved in middle; gills 3-4 similar in resemblance; gill 5 broader than gills 3-4; gill 6 as large as gill 2.

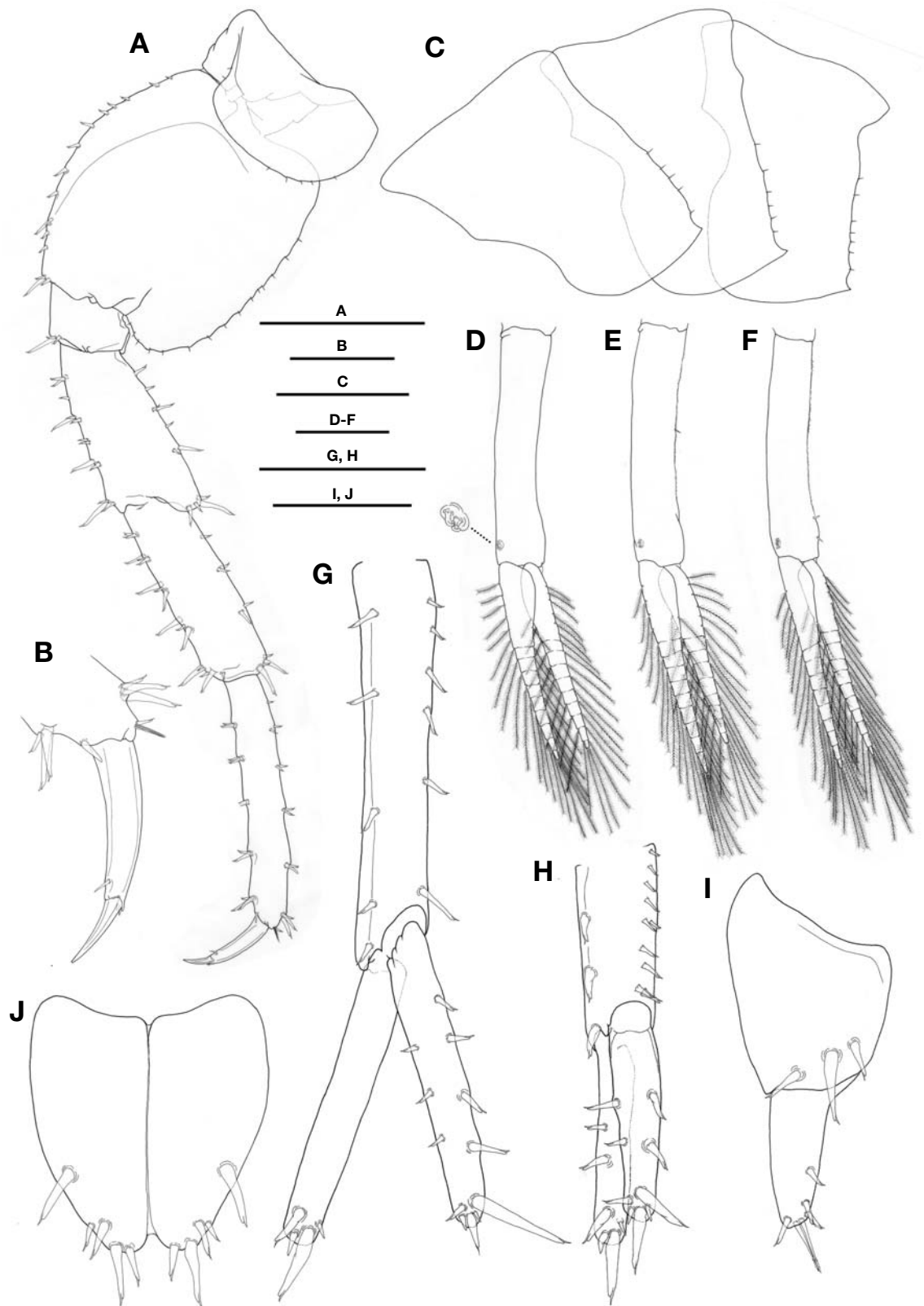
Epimeral plates 1-3 (Fig. 4C) with weakly pointed posterior angles, ventral margin marginally bare and posterior margin with 5-7 simple setae.

Pleopods 1-3 (Fig. 4D-F) well developed, subequal in length; peduncles of all pleopods with two retinaculae distally, both

rami with about 8-10 articles, armed with plumose setae; peduncle of pleopod 1 marginally bare; peduncle of pleopod 2 with one simple seta in middle part of outer margin; peduncle of pleopod 3 with two simple setae in distal part of outer margin.

Uropod 1 (Fig. 4G), peduncle with two rows of 4-6 marginal cuspidate setae and distolateral cuspidate seta; outer ramus about 0.79 times of peduncle, marginally bare, distal margin





**Fig. 4.** *Platorchestia monodi*, male. A, Pereopod 7; B, Dactyl of pereopod 7; C, Epimeral plates 1-3; D, Pleopod 1; E, Pleopod 2; F, Pleopod 3; G, Uropod 1; H, Uropod 2; I, Uropod 3; J, Telson. Scale bars: A, C=1 mm, D-H=0.5 mm, B, I, J=0.25 mm.

with four cuspidate setae; inner ramus with three, four, and five cuspidate setae on inner, outer, and distal margins, respectively.

Uropod 2 (Fig. 4H), peduncle with three cuspidate setae on outer margin, inner margin with 10 cuspidate setae; outer ramus with two marginal and four distal cuspidate setae, inner ramus with two, two, and five cuspidate setae on inner, outer, and distal margins respectively.

Uropod 3 (Fig. 4I), peduncle slightly broadened dorsally, with three dorsal cuspidate setae; ramus slightly shorter than peduncle, with one marginal cuspidate seta, distal margin with two long simple and three short cuspidate setae.

Telson (Fig. 4J) subtriangular in shape, distally notched,

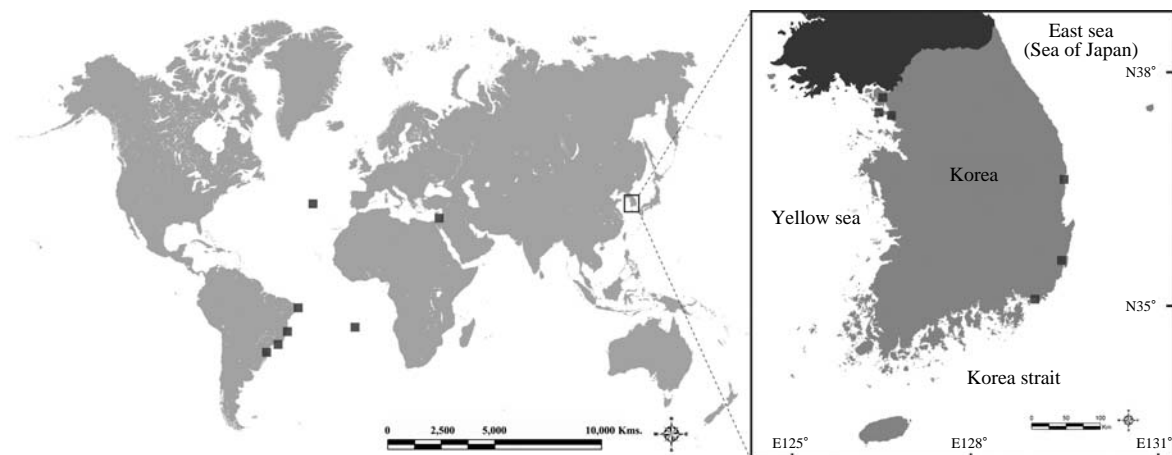
with medial suture-line on dorsal surface; each lobe with two groups of 1-2 lateral cuspidate setae and two apical cuspidate setae.

**Habitat.** This species lives in river mouth or sea shore. They were usually found under rotting hay or in silt beside the water (Fig. 5).

**Molecular data.** CO1 gene sequences (GenBank accession no: JN712919-JN712930) were obtained from 12 individuals of *P. monodi*. The 667-bp CO1 sequence contained 7 variable sites and 660 conserved sites, while 6 sites were parsimony-informative. Sequence alignment was straightforward without any insertion and deletion. The amino acid translations with invertebrate mitochondrial code, stop codons were



**Fig. 5.** Habitat of *Platorchestia monodi*: A, Yeonangyo Bridge; B, Rotting hay.



**Fig. 6.** Distribution of *Platorchestia monodi* based on previous records and on the present study. References are: *P. monodi* (■) by (Mateus et al., 1986; Stock and Biernbaum, 1994; Morino and Ortal, 1995; Stock, 1996; Serejo, 2004).

**Table 1.** Morphological differences between Korean *Platorchestia monodi* those from other countries

Character (male) and distribution	Korean materials	Mid-Atlantic islands materials	Brazilian materials	Israeli materials
Coxal plate 6	Posterior lobe, anterodistal corner right angled, without process ventrally	Posterior lobe, anterodistal corner right angled, with process ventrally	Posterior lobe, anterodistal corner right angled, without process ventrally	Posterior lobe, anterodistal corner right angled, without process ventrally
Pleopods 2-3	Peduncle with 1-2 simple setae	N/A	Peduncle with 4-5 simple setae	Peduncle with 5-6 simple setae
Uropod 1	Inner ramus with three cuspidate setae on inner margin	Inner ramus with three cuspidate setae on inner margin	Inner ramus with five cuspidate setae on inner margin	Inner ramus with four cuspidate setae on inner margin

N/A, not available.

not found.

**Remarks.** Mateus et al. (1986) first reported this species from the sea shores of the Azores Island in Portugal. According to a recent study, present species is mainly distributed from the Atlantic region such as Mid-Atlantic islands, Brazilian coast, and Israel (Mateus et al., 1986; Stock and Biernbaum, 1994; Morino and Ortal, 1995; Stock, 1996; Serejo, 2004). In this paper, this species was reported for the first time from the Pacific region (Fig. 6).

This species is characterized by the following features: (i) antenna 2 (♂), peduncular articles 4-5 weakly incrassate; (ii) gnathopod 1 (♂), dactyl cuspidactylate; (iii) propodus of gnathopod 2 (♂), posterior margin marginally bare and palmar margin with two protrusions, these protrusions wide and shallow; (iv) coxal plate 6, anterodistal corner of posterior lobe rounded; and (v) pereopod 7 (♂) not sexually dimorphic (merus and carpus not expanded).

In general, Korean *P. monodi* is in good accordance with the descriptions and illustrations of Mid-Atlantic islands (Mateus et al., 1986; Stock and Biernbaum, 1994; Stock, 1996), Brazilian (Serejo, 2004), and Israeli materials (Morino and Ortal, 1995). However, the Korean materials differ from those of other countries in the following features: (i) the coxal plate 6, shape of anterodistal corner in posterior lobe; (ii) the distribution pattern of simple setae on peduncles of pleopods 2-3; and (iii) the number of cuspidate setae on inner margin in uropod 1. A comparison between Korean materials and samples from other countries is given in Table 1.

The partial CO1 sequence of this species was determined for the first time and registered at GenBank. This genetic data would be helpful in the study of the speciation processes, radiation patterns, and cryptic species diversity.

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## REFERENCES

- Bousfield EL, 1982. The amphipod superfamily Talitroidea in the northeastern Pacific Region. 1. Family Talitridae: systematics and distributional ecology. Publications in Biological Oceanography, 11:1-73.
- Cheng YT, Nakazono K, Lin YK, Chan BKK, 2011. Cryptic diversity of the semi-terrestrial amphipod *Platorchestia japonica* (Tattersall, 1922) (Amphipoda: Talitridae: Talitridae) in Japan and Taiwan, with description of a new species. Zootaxa, 2787:1-18.
- Clare EL, Lim BK, Engstrom MD, Eger JL, Hebert PDN, 2007. DNA barcoding of Neotropical bats: species identification and discovery within Guyana. Molecular Ecology Notes, 7:184-190.
- Elsasser SC, Floyd R, Hebert PDN, Schulte-Hostedde AI, 2009. Species identification of North American guinea worms (Nematoda: Dracunculus) with DNA barcoding. Molecular Ecology Resources, 9:707-712.
- Folmer O, Black M, Hoeh W, Vrijenhoek R, 1994. DNA primers for amplification of mitochondrial cytochrome c oxidase subunit I from diverse metazoan invertebrates. Molecular Marine Biology and Biotechnology, 3:294-299.
- Garm A, 2004. Revising the definition of the crustacean seta and setal classification systems based on examinations of the mouthpart setae of seven species of decapods. Zoological Journal of the Linnean Society, 142:233-252.
- Hajibabaei M, Janzen DH, Burns JM, Hallwachs W, Hebert PDN, 2006. DNA barcodes distinguish species of tropical Lepidoptera. Proceedings of the National Academy of Sciences of the United States of America, 103:968-971.
- Jo YW, 1988. Talitridae (Crustacea-Amphipoda) of the Korean

- coasts. *Beaufortia*, 38:153-179.
- Mateus A, Mateus E, Afonso O, 1986. Amphipodes Littoraux et de l'intérieur recueillis aux Açores pendant la Campagne "Biacores" (1971) sur le navire Jean Charcot. *Anais da Faculdade de Ciencias do Porto*, 65:87-126.
- Miyamoto H, Morino H, 2004. Taxonomic studies on the Talitridae (Crustacea, Amphipoda) from Taiwan. II. The genus *Platorchestia*. *Publications of the Seto Marine Biological Laboratory*, 40:67-96.
- Morino H, Ortal R, 1995. Two *Platorchestia* species (Amphipoda, Talitridae) from Israel. *Crustaceana*, 68:824-832.
- Rafinesque CS, 1815. Analyse de la nature ou tableau de l'univers et des corps organisés. De L'Imprimerie de Jean Bar-ravecchia, Palerme, pp. 1-224.
- Serejo CS, 2004. Talitridae (Amphipoda, Gammaridea) from the Brazilian coastline. *Zootaxa*, 646:1-29.
- Serejo CS, Lowry JK, 2008. The coastal Talitridae (Amphipoda: Talitroidea) of Southern and Western Australia, with comments on *Platorchestia platensis* (Krøyer, 1845). *Records of the Australian Museum*, 60:161-206.
- Stock JH, 1996. The genus *Platorchestia* (Crustacea, Amphipoda) on the Mid-Atlantic islands, with description of a new species from Saint Helena. *Miscel-lània Zoològica*, 19.1:149-157.
- Stock JH, Biernbaum CK, 1994. Tesseltrial Amphipoda (Talitridae) from ascension and Saint-Helena (South Cental Atlantic). *Journal of Natural History*, 28:795-811.
- Tattersall WM, 1922. Zoological results of a tour in the Far East. Amphipoda with notes on an additional species of Isopoda. *Memoirs of the Asiatic Society of Bengal*, 6:437-459.
- Zemlak TS, Ward RD, Connell AD, Holmes BH, Hebert PDN, 2009. DNA barcoding reveals overlooked marine fishes. *Molecular Ecology Resources*, 9 (Suppl 1):237-242.
- Zimmer A, Araujo PB, Bond-Buckup G, 2009. Diversity and arrangement of the cuticular structures of *Hyaella* (Crustacea: Amphipoda: Dogielinotidae) and their use in taxonomy. *Zoologia*, 26:127-142.

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